APPENDIX A

RECORD OF DECISION

VIRGIN ISLAND CHEMICAL SUPERFUND SITE
ST. CROIX, U.S. VIRGIN ISLANDS

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION II
NEW YORK, NEW YORK

DECLARATION FOR THE RECORD OF DECISION

SITE NAME AND LOCATION

Virgin Island Chemical Superfund Site
Estate Bethlehem Middle Works
St. Croix, U.S. Virgin Islands
CERCLJS ID No. VID98065 1095

STATEMENT OF BASIS AND PURPOSE

This decision document presents the U.S. Environmental Protection Agency's (EPA's) Selected Remedy for the Virgin Island Chemical Superfund Site ("the Site"), located in Estate Bethlehem Middle Works in the south-central portion of St. Croix in the U.S. Virgin Islands, which was chosen in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. Sections 9601-9675, as amended, and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR Part 300. This decision document explains the factual and legal basis for selecting the remedy for the Site. The information supporting this remedial action decision is contained in the administrative record for the Site. The administrative record index is zttached (see Appendix D).

The Virgin Islands Department of Planning and Natural Resources (VIDPNR) has been consulted and concurs with the Selected Remedy (see Appendix E).

ASSESSMENT OF THE SITE

The response action selected in this Record of Decision (ROD) is necessary to protect public health or welfare or the environment from actual or threatened releases of pollutants or contaminants from the Site which may present an imminent and substantial endangerment to public health or welfare or the environment.

DESCRIPTION OF THE SELECTED REMEDY

The remedy selected is the only operable unit for the Site.

EPA's Selected Remedy for the Site includes soil vapor extraction/air sparging (SVE/AS), monitored natural attenuation (MNA), and institutional controls. The Selected Remedy was presented in the Final Feasibility Study Report (FS) and is described in further detail below. The FS evaluated and screened remedial alternatives for contaminated soil and groundwater at the Site. The FS used a comparative analysis to evaluate five alternatives and identify the advantages and disadvantages of each. EPA selected the remedy for the Site based upon the results of the FS.

The Selected Remedy for contaminated soil and groundwater includes the following features:

- Use and expansion of the existing SVE/AS system to treat contaminated groundwater, saturated soil, and unsaturated soil at the Aboveground Storage Tank **(AST)** source area;

- Use of MNA to address low-level residual contamination in groundwater at the Former Process Pit (FPP) area and downgradient areas; and

- The Department of Planning and Natural Resources in consultation with **EPA,** will utilize institutional controls (in the form of existing **well** permitting laws and regulations) to limit the pumping of groundwater at the Site to prevent interference with the selected remedy and to also prevent human exposure to contaminated groundwater until MCLs are achieved.

The Selected Remedy is protective of human health and the environment through the following:

1. Active source control and contaminant mass removal will occur at the **AST** area via use of an SVE/AS system to remove ethylbenzene and xylene from the source area soils and **from** groundwater to achieve soil SSLs and groundwater MCLs. **AS** treatment will also enhance conditions for aerobic biodegradation of these contaminants.

2. Natural attenuation of low-levei residual volatile organic compound (VOC) contamination, mainly chlorofoim, in groundwater will continue in the FPP area under closely monitored conditions until groundwater MCLs are achieved.

3. The Department of Planning and Natural Resources will utilize institutional controls (in the form of existing well permitting laws) to limit the pumping of groundwater at the Site to prevent interference with the selected remedy and to also prevent human exposure to contaminated groundwater until MCLs are achieved.

In addition to the Selected Remedy, EPA has retained groundwater extraction and treatment as a contingency remedy for the groundwater in the **AST** and FPP areas. This contingency remedy will be implemented in the even? that analyses of groundwater monitoring data indicate that: 1) the groundwater plume exceeding MCLs is migrating downgradient and could potentially move beyond the Island Chemical property boundary line or **2)** MCLs will not be achieved anywhere in ?heaquifer within a time frame that is reasonable compared to that offered by the contingency remedy.

The decision to implement the contingency remedy will be made by **EPA,** in its sole discretion, according to criteria specified in Section 1**1.3** of the ROD.

STATUTORY DETERMINATIONS

The Selected Remedy attains the mandates of CERCLA Section 121 and, to the extent practical, the NCP. Specifically, the Selected Remedy is protective of human health and the environment, complies with federal and territorial requirements that are applicable or relevant and appropriate to the remedial action, is cost-effective, and utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable.

This remedy also satisfies the statutory preference for treatment as a principal element of the remedy (*i.e.*, reduces the toxicity, mobility, or volume of hazardous substances, pollutants, or contaminants as a principal element through treatment).

Because this remedy may result in hazardous substances, pollutants, or contaminants remaining on-Site above levels that allow for unlimited use and unrestricted exposure for approximately 5 years, a review will be conducted no less often than once every five years after initiation of remedial ection to ensure that the remedy is: or will be, protective of human health and the environment.

ROD DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Summary section of this ROD. Additional information can be found in the Administrative Record file for this Site.

- Chemicals of concern (COCs) and their respective concentrations.
- Baseline risk represented by the COCs.
- Cleanup levels established for COCs and the basis for these levels.
- Techniques for addressing source materials that constitute principal threats.
- Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of ground water used in the baseline risk assessment and ROD.
- Potential land and ground-water use that will be available at the Site as a result of the Selected Remedy.
- Estimated capital, annual operation and maintenance, and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected.
- Key factors that led to selecting the remedy.

8/13/02

Jane M. Kenny
Regional Administrator
U.S. Environmental Protection Agency, Region II

Date

RECORD OF DECISION
DECISION SUMMARY

VIRGIN ISLAND CHEMICAL SUPERFUND SITE
ST. CROIX, U.S. VIRGIN ISLANDS

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1.0 INTRODUCTION

1.1 Site Name, Location, and Description

The Virgin Island Chemical Superfund Site ("the Site") includes a former chemical facility and properties located at Plot 13Q (approximately 3.5 acres) of Estate Bethlehem Middle Works in the south-central portion of St. Croix in the U.S. Virgin Islands (see Figure 1). Site access is via Route 66, which traverses the island east and west and abuts the south-southwest boundary of the Site. Plot 13Q is bordered to the north and east by an intermittent stream, the River Gut, which originates north of the Site and drains to the Caribbean Sea. The River Gut joins the Bethlehem Gut approximately 800 feet southeast of the Site. They are collectively then called the Fairplain Gut. The groundwater underlying the Site flows predominantly to the south-southeast.

Land use surrounding the Site is mostly industrial and commercial. A water service company and an undeveloped lot exist immediately to the west and northwest of the Site. A concrete batch plant and two automobile repair shops are located east-northeast of the Site, on the opposite side of the River Gut. Two paving companies are located north-northwest of the Site across the River Gut. The Henry Rohlsen Airport (formerly known as the Alexander Hamilton Airport) is situated about 1,500 feet south of the Site and a prison lies 0.25 mile to the northwest. Two residential properties are located about 0.33 mile north and 0.75 mile northwest of the Site.

Plot 13Q is owned by CHS Holding Corporation and is currently unoccupied and overgrown with heavy vegetation. A chain-link fence was installed in Spring 2000 along the property line to secure the area from unauthorized access.

Over half of the property was covered by buildings and/or process equipment from past pharmaceutical manufacturing and blending operations. Certain of the potentially responsible parties demolished the buildings in the Spring of 2002. There are no remaining structures except a concrete pad that housed the buildings.

Two storm drains are located on-Site. The Central Storm Drain runs beneath the paved area between the former laboratory and maintenance buildings. The Southern Storm Drain, where observed, is a concrete-lined depression along the southern wall of the former maintenance building and the edge of the reactor area. Both storm drains discharge to the River Gut.

1.2 Site History and Removal Action

From 1968 to 1982, the Site was used for a variety of pharmaceutical manufacturing and blending operations under a number of different corporate entities. In general, toluene, pyridine, and quinidine (chemicals used by many of the occupants) have been historically spilled or otherwise released in significant volumes at the Site.

In October 1982, EPA was notified of the facility's impending closure and off-Site removal of waste materials. Between 1984 and 1991, several investigations were conducted at the Site by EPA and a former tenant, Island Chemical Company, which was later acquired by Berlex

Laboratories Inc. (Berlex). This investigative work identified six areas of potential environmental concern (see Figure *2):*

(1) Laboratory and Warehouse Building
(2) Aboveground Storage **Tank** (AST) Area
(3) Former Process Pit (FPP) Area
(4) Loading Dock/Former Laboratory Pit Area
(5) **Soil** Beneath Concrete Pad Near ASTs (northern comer of the Site), and
(6) Concrete Storage Pad (north of the laboratory **and** warehouse buildings).

During the initial assessment stages of **the** Site **by** regulatory agencies, both EPA and Berlex conducted several response activities. These activities included soil excavation with on-Site treatment (e.g., drying trays) or off-Site disposal, drum removals, and off-Site disposal of AST contents.

Between September 1989 and October 1991, EPA conducted a removal action at the Site. At that time, the laboratory/warehouse building was found to contain approximately **400** drums (some extremely deteriorated), leaking cylinders of chlorine and hydrogen chloride, and over 800 containers of laboratory reagents that included sodium metal, potassium cyanide, and ethyl ether. EPA removed **354** drums containing **14,720** gallons of various chemicals and 8,061 pounds of lab pack chemicals from the laboratory/warehouse building.

On June **17,** 1996, the Site was placed on the National Priorities List. On September **29, 1994,** EPA entered into an Administrative Order on Consent (AOC), Index No. II CEKCLA-94-0401, with Berlex and Island Chemical Company. Pierrel S.p.A, a subsidiary of Pharmacia Corporation and also a former tenant at the Site, was added **as a** Respondent to this AOC in April 1999. The AOC required the performance of a Remedial Investigation and Feasibility Study (RI/FS) at the Site.

The **primary** objectives of the RI were to: 1) collect the data needed to characterize the nature and extent of contamination and adequately support human health and ecological baseline risk assessments and **2)** provide a basis on which **a** subsequent, cost-effective, remedial action plan would be recommended. The following specific data requirements were addressed:

- Background concentrations of inorganic contaminants in surface soil through sampling and analysis;
- Nature and extent of potential surface and subsurface soil impacts on the Site through sampling and analysis;
- Nature and extent of potential groundwater impacts through monitoring well installation and sampling and analysis;
- Site-specific geologic and hydrogeologic conditions through lithologic evaluation, water level measurements, etc.; and

- Nature and extent of potential soil/sediment contamination in the Gut System (*i.e.*, River, Bethlehem, and Fairplain Guts) through sampling and analysis.

All six areas of potential concern were investigated during the initial assessment and the subsequent RI. Based on the data collected, only the AST and FPP areas were determined to require remediation.

2.0 HIGHLIGHTS OF COMMUNITY PARTICIPATION

Public participation in the remedy selection process is required by CERCLA Sections 113 and 117, 42 U.S.C. Sections 9613 and 9617, and 40 CFR Section 300.430(f)(3) of the NCP. These sections require that, before adoption of any plan for remedial action to be undertaken by EPA, the State, or an individual (e.g., potentially responsible party), the lead agency shall:

1. Publish a notice and make the Proposed Plan available to the public, and

2. Provide a reasonable opportunity for submission of written and oral comments and an opportunity for a public meeting at or near the Site regarding the Proposed Plan and any proposed Endings relating to cleanup standards. The lead agency shall keep a transcript of the meeting and *make* such transcript available to the public. The information made available to the public under item 1, above, shall provide a reasonable explanation of the Proposed Plan and alternative proposals considered.

Additionally, notice of the final remedial action plan set forth in the ROD must be published, and the plan must be made available to the public before commencing any remedial action. Such a final plan must be accompanied by a discussion of any significant changes to the preferred remedy presented in the Proposed Plan along with the reasons for the changes. A response (Responsiveness Summary) to each of the significant comments, criticisms, and new data submitted in written or oral presentations during the public comment period must be included with the ROD.

A summary of community involvement activities at the Site follows:

November 1994 - EPA visited the Site and spoke to representatives or owners of the businesses and restaurants adjacent to the Site about upcoming sampling activities.

January 1995 - EPA delivered a fact sheet door-to-door to affected businesses and nearby residents. The fact sheet explained the nature of the contamination and the need for the RI.

February 15,1995 - EPA held a public meeting at the Department of Education Curriculum Center to present the RI work plan and to answer questions from the community.

August 1995 - EPA completed a Community Relations Plan for the Site, which documented community concerns expressed during the November **1994** visits and the February **1995** pubic meeting.

September 1997 - EPA prepared and distributed another fact sheet describing completed and ongoing remedial investigation activities.

June 27,2001 - EPA released the RI and FS reports and the Proposed Plan for public comment. These documents were made available to the public in **the EPA** Docket Room in Region 11, New York and the information repository at the University of the Virgin Islands, St. Croix Campus Library, Kingshill, St. Croix. A notice announcing the public comment period and a public meeting, along with the availability of the RI and FS reports and Proposed Plan, was published on June **27,2001.** The public comment period originally **was** scheduled from June **27** through July **27,2001.** In response to public request for additional time, EPA extended the public comment period an additional **15** days to August **11,2001.**

July 12,2001 - EPA and VIDPNR hosted a public meeting to present the conclusions of the RI/FS, further elaborate on the reasons for recommending the Preferred Alternative, and to receive public comments. The meeting was held at **7:00** p.m. at the Department of Education Curriculum Center on Centerline Road in Kingshill, St. Croix. Representatives from EPA presented the Proposed Plan, which discussed the following five alternatives:

- Alternative **1**: No Further Action
- Alternative **2:** Monitored Natural Attenuation (MNA) with Institutional Controls
- Alternative 3: Soil Vapor Extraction/Air Sparging (SVE/AS) for the AST area, MNA for the FPP area, and Institutional Controls
- Alternative 4: SVE/AS for the XST area, Groundwater Extraction and Treatment for the FPP area, and Institutional Controls
  Alternative *5:* Groundwater Extraction 2nd Treatmen?fcr the AST area, MNA for the FPP area, and Institutional Controls

Alternative 3 was presented **as** EPA's Preferred Alternative. In addition, EPA proposed to retain Alternative **4** as a contingency remedy that would be implemented in the event that the analyses of future groundwater monitcnng data indicate that active remediation of the contaminated groundwater is appropriate. **A** portion of the meeting **was** dedicated to answering questions **and** accepting formal oral comments from the public. Community acceptance ***of*** the Selected Remedy is discussed in Section **9.0,** Summary of Comparative Analysis of Alternatives, of this Decision Summary.

EPA's response to comments received during the public comment period **is** included in the Responsiveness **Summary,** which is part **of** this ROD, **and is** designated as Appendix C.

3.0 SCOPE AND ROLE OF RESPONSE ACTION

This is the first and only operable unit at the Site.

The Selected Remedy addresses soil and groundwater contamination in the AST area and groundwater contamination in the FPP area at the Virgin Island Chemical Superfund Site. The Selected **Remedy will use a soil** vapor extraction/air sparging system to treat groundwater, saturated soil, and unsaturated **soil** at the **AST area and MNA** to address groundwater in the FPP area. The Department of **Planning** and Natural Resources **will** utilize institutional controls (in the form of existing well permitting laws) to limit the pumping of groundwater at the Site to prevent interference with the selected remedy and to also prevent human exposure to contaminated groundwater until MCLs are achieved.

The Selected Remedy is necessary to protect human health and the environment.

4.0 SUMMARY OF SITE CHARACTERISTICS

RI/FS activities were conducted at the Site, with EPA and VIDPNR oversight, **from** 1994 to 2000. The primary objectives of the RI were to: 1) collect the data needed to characterize the nature and extent of contamination and adequately support human health and ecologica! baseline **risk** assessments and **2)** provide a basis on which a subsequent, cost-effective, remedial action plan would be recommended.

The RI field investigation was completed in four phases from 1995 through 1998. Six areas of potential environmental concern were investigated (see Figure **2):**

(1) Laboratory arid Warehouse Building
(2) Aboveground Storage Tank (AST) Area
(3) Former Process Pit (FPP) Area
(4) Loading Dock/Former Laboratory Pit Area
(5) Soil Beneath Concrete **Pad** Near ASTs (northern corner of the Site)
(6) Concrete Storage Pad (north of the laboratory and warehouse buildings)

The following Site-specific data were collected **as** part of these investigations:

- Background concentrations **of** constituents in surface soils
- Nature and extent **of** potential surface **and** subsurface soil impacts on Site
- Nature and extent of potential groundwater impacts on Site/off Site
- Site-specific geologic and hydrogeologic conditions
- Nature and extent of potential soil/sediment impacts in the Gut system (*i.e.*, River, Bethlehem, and Fair Plains Guts).

The FS was initiated subsequent to completion of the RI, which included the collection of supplemental RI data and the performance of an SVE/AS pilot study in the AST and FPP areas in 2000.

The results of the RI investigation are summarized below. The results of the SVE/AS pilot study, which was conducted as part of the FS, are further discussed in Section 8.0.

4.1 Geology and Hydrogeology

Geology

The Site geology generally consists of approximately 90 feet of fill and alluvium overlying the clayey marl of the Kingshill Formation (see Figures 2 and 3).

- Fill material [thickness varies from 0 to approximately 10 feet below ground surface (bgs)]- Consists of reworked alluvium material, as described below.

- Alluvium (to approximately 90 feet bgs) - Consists of brown and grey clay-rich sediments with lesser and varying amounts of silt and fine sand. Entrained within the clay-rich matrix to approximately 30 to 40 feet bgs are more permeable sand and gravel lenses. These lenses are localized and not uniform or continuous across the Site.

- Kingshill Formation (below approx. 90 feet bgs) - Consists of white to light brown and grey, stiff clay with lesser amounts of sand.

Hydrogeology

The water table depth fluctuates from approximately 10 to **30** feet bgs according to precipitation, which generally varies according to an annual cycle.

Multiple rounds of groundwater level measurements were taken during the RI to characterize groundwater flow during both the wet and dry periods. Based upon the results of these measurements, it was determined that two distinct water-bearing zones exist within the alluvium. The "shallow" alluvium zone corresponds to the interval between 0 to approximately 50 feet bgs, and the "deep" alluvium zone refers to the interval between approximately 50 to 100 feet bgs. The characteristics of these zones are illustrated on the groundwater elevation iso-contour maps (see Figures **4** to **7)** and hydrographs (see Figures 8 and 9) included in Appendix **A.**

Figures **4** through **7** contain interpreted groundwater elevation contours in the shallow and deep alluvium during **high** (*i.e.*, March 6,2000) and low (*i.e.*, October 21, 1998) water table conditions. The predominant groundwater flow direction within both the shallow and deep alluvium is to the south-southeast, with a localized easterly flow component also apparent in the shallow alluvium proximal to monitoring well MW-10 during high water table conditions. Horizontal gradients in the shallow and deep alluvium range **from** approximately 0.002 to 0.014 feet **per** foot **(ft/ft)** apd from 0.003 to 0.014 **ft/ft,** respectively. The vertical gradients between the shallow and deep

alluvium are consistently downward and range from -0.005 to -0.11 ft/ft. The hydraulic conductivities for the shallow and deep alluvium ranged from 0.90 to 18.14 feet per day (ft/d) and from 2.73 to 5.65 ft/d, respectively.

Figures 8 and 9 contain the results of continuous water level measurements from two shallow/deep well pairs (MW-6MW-8 in the AST area, MW-2MW-7 in the FPP area), respectively, along with corresponding precipitation data for a period of approximately 3 weeks. In both cases, the hydrograph for the deep well exhibited a response (*i.e.*, a corresponding change in water level) to off-site pumping, whereas the shallow well exhibited a steady decline and no response to off-site pumping. This information supports the conclusion that an aquitard exists between the shallow and deep alluvium, which prevents direct hydraulic communication between theses two zones. This conclusion is further supported by the distribution of groundwater contaminants, as further discussed in Section 4.3.

4.2 Soil

Surface Soil

The analytical results from surface soil samples were compared to EPA's SSLs, risk-based screening levels derived from other EPA guidance documents, and Site background concentrations (for metals only). Arsenic was detected above the risk-based screening level of 3.83 parts per million (pprn) (non-detected to 8.8 ppm); iron was detected above twice the Site background concentration of 31,933 ppm (18,100 ppm to 63,400 ppm); and manganese was detected above the risk-based level of 1,600 ppm (311 ppm to 2,100 ppm) in several samples. Based upon further evaluation of the data as part of the risk assessment (see Section 6.0), no contaminants of significant concern were identified in the surface soil.

Subsurface Soil

The analytical results from subsurface soil samples were compared to EPA's SSLs for protection of groundwater and to Site background concentrations (for metals only). Based on these comparisons and the groundwater data collected during the RI, metals and semi-volatile organic compounds (SVOCs) were not considered to be a significant concern.

The predominant contaminants determined to have impacted subsurface soils in the AST area were ethylbenzene (7 parts per billion (ppb) to 320,000 ppb) and xylene (2 ppb to 2,000,000 ppb). The SSLs for ethylbenzene and xylene are 6,500 ppb and 90,000 ppb, respectively. The impacted subsurface soils generally encompass an on-Site area between Tanks 3 and 10 (see Figure 10). The zone of impact was estimated to be approximately 7,800 square feet (sf) in area and to extend from two feet bgs to the water table interface (approximately 25 feet bgs).

While concentrations of chloroform were not detected above the SSL of 600 ppb (maximum concentration of chloroform was 410 ppb), this chemical was included as a contaminant of potential concern (COPC) based upon its detection in groundwater. The subsurface soils within a 400-square-foot area, from 20 to 25 feet bgs, near monitoring well MW-2 (*i.e.*, the location where

highest concentrations of chloroform were detected in groundwater; see Figure 13), were conservatively assumed to be impacted with chloroform.

4.3 Groundwater

The following volatile organic compounds (VOCs) were detected above the federal Maximum Contaminant Levels (MCLs) in groundwater: ethylbenzene, xylene, and chloroform. Groundwater quality in the AST area was determined to be impacted by ethylbenzene (700 ppb to 23,000 ppb) and xylene (27,000 ppb to 110,000 ppb). The MCLs for ethylbenzene and xylene are 700 ppb and 10,000 ppb, respectively. Concentration iso-contour maps illustrating the 1998 extent of the ethylbenzene and xylene contamination exceeding MCLs in groundwater-are included as Figures 11 and 12, respectively. In 1998, the area and depth of groundwater impact above MCLs were estimated to be approximately 14,000 sf and 40 to 50 feet bgs, respectively, based upon the results of groundwater samples collected from shallow monitoring wells MW-1, MW-6 and MW-10, deep monitoring well MW-8, and multiple geoprobe and temporary well sampling locations. The most recent results from groundwater sampling completed during the period of March to May 2000 indicate that the groundwater plume is not expanding. Ethylbenzene and xylene were not detected in any of the existing off-Site production wells.

Groundwater quality in the FPP area was determined to be impacted by chloroform The MCL for chloroform is 100 ppb. A concentration iso-contour map illustrating the 1998 extent of chloroform contamination exceeding MCLs in groundwater is inciuded as Figure 13. In 1998, the area and depth of impact above the MCL was estimated to be approximately 3,000 sf and 40 to 50 feet bgs, respectively, based upon the results of groundwater samples collected from shaliow monitoring wells MW-2 and MW-11, deep monitoring well MW-7, and multiple geoprobe and temporary well sampling locations (96 ppb to 3,800 ppb). The most recent results from groundwater sampling completed during the period of March to May 2000 indicate that chloroform concentrations (38 ppb to 76 ppb) have decreased below the MCL, excluding the localized area of temporary well FPP-VMP-1D (25 - 137 ppb; located 10 feet from MW-2). Chloroform was not detected in any off-Site production wells.

Methylene chloride was also notably detected in groundwater at both the AST and FPP areas. However, methylene chloride was also detected in field, trip, and laboratory blanks and at concentrations that can be attributed to laboratory contamination rather than actual Site conditions. To be conservative, this chemical was included as a COPC

4.4 Gut System

Several metals were detected at the reference location (RG-2), uspstream of Plot 13Q, in the River Gut. The distribution of these metals was generally variable throughout the Gut System. However, a slight increase in the concentration of certain metals was noted at several locations downstream of the facility and at one location in the Bethlehem Gut.

These elevated concentrations in the River Gut are likely the result of the depositional nature of the locations. No metals were detected above EPA SSLs and, thus, they are not of concern.

4.5 Fate and Transport

The existing data obtained during the RI/FS support the following conclusions:

1) An active source of ethylbenze and xylene contamination exists in the unsaturated zone soils at the AST area, which will continue to impact the underlying groundwater quality at concentrations exceeding MCLs. However, the existing groundwater data indicate that ethylbenzene and xylene plumes exceeding MCLs have reached steady state as a result of natural attenuation processes (e.g., biodegradation, adsorption, dilution) and, hence, are not expanding or migrating beyond their current position. The groundwater plumes exceeding MCLs in this area generally coincide, extend just north of the Site property boundary, and have not impacted off-Site production wells. The current impact to groundwater quality will persist so long as the active source remains present.

2) An active source of chloroform contamination was not identified in the FPP area. Existing groundwater data indicate that the chloroform plume is contracting as a result of natural attenuation processes, with current groundwater quality in this area predominantly conforming with MCLs. The groundwater plume exceeding MCLs is within the Plot 13Q property boundary and has not impacted off-Site production wells.

5.0 CURRENT AND POTENTIAL FUTURE LAND USE

The Revised Final Euman Health Risk Assessment (2000) considered both current and potential future land use scenarios. The Site and the surrounding area have been generally developed for various commercial/industrial uses, and it is reasonable to assume that such uses will continue into the extended future. The exposure pathways of ingestion, inhalation, and dermal absorption via contact with the COPCs in groundwater, soils, and sediments were identified for evaluation. Potential human receptor populations were evaluated for each pathway and either ruled out or included in the risk assessment. This evaluation identified the following possible exposure pathways:

5.1 Current Land Use

- Residential (child/adult) exposure to groundwater via six off-Site wells was evaluated. This pathway was deemed incomplete as no COPCs were identified for the groundwater from these off-Site wells in the immediate vicinity of the Site.

- Trespasser (pre-adolescent/adult) exposure to COPCs in the surface soil/sediment collected from the Site and the stream system (Gut System) was evaluated for three pathways (incidental ingestion, dermal contact, and inhalation of particulates). Pre-adolescent children were assumed to be those between 7 and 12 years of age.

5.2 Future Land Use

- Industrial/Commercial (adult) exposures on-Site to COPCs in groundwater, surface soil, and sediment were evaluated for three pathways (ingestion, inhalation of VOCs (groundwater) and particulates (soil and sediment), and dermal contact).

- Construction worker (adult) exposures on-Site to COPCs in surface soil, subsurface soil (up to 12 feet bgs), and soil/sediment in the Gut System were evaluated for three pathways (incidental ingestion, dermal contact, and inhalation of particulates). Exposure to groundwater was not evaluated for this receptor since groundwater at the Site is generally encountered at depths between 18 and 20 feet bgs. Since construction activities are not anticipated to occur at such depths, exposure to groundwater was not considered. In addition to evaluating the potential for risk associated with direct contact with contaminants in subsurface soil, the same data also were compared to EPA's SSLs to determine if concentrations could adversely impact groundwater through migration (leaching).

- Off-Site residential (child/adult) exposures to COPCs in groundwater were evaluated for three pathways (ingestion, dermal contact, and inhalation of particulates or VOC vapors). For this scenario, it was assumed that on-Site concentrations could be present in an off-Site well for the entire exposure duration. In reality, no COPCs were detected in the off-Site wells or in the wells at the edge of the Site nor are they expected to reach these areas in the future, as discussed in Sections 4.1 and 4.3. Therefore, the exposure assumptions used in this scenario are extremely conservative.

6.0 SUMMARY OF SITE RISKS

Based upon the results of the RI, a baseline risk assessment was conducted to estimate the risks associated with current and future Site conditions. A baseline risk assessment is an analysis of the potential adverse human health and ecological effects caused by hazardous substance releases from a Site in the absence of any actions to control or mitigate these under current and future land uses. The results of the baseline risk assessment are discussed below and summarized on Tables 1 through 10.

6.1 Human Health Risk

An evaluation was made of all potential exposure routes which cause exposure to chemicals of potential concern at the Site for people living or working in the area. The estimated carcinogenic risks and noncarcinogenic hazards were compared to EPA guidelines and generally-accepted target risk levels. Carcinogenic risks falling within the target range of 1×10^{-6} to 1×10^{-4} and noncarcinogenic hazards less than 1 were considered to be below the statutory threshold.

Under a future land use scenario, the cumulative carcinogenic risk estimates for exposure to groundwater for the industrial/commercial worker (9×10^{-4}), the adult resident (8×10^{-4}) and the child resident (4×10^{-4}) exceed EPA's target risk range. These exposure scenarios assumed that the on-Site groundwater would be used as a potable water source for drinking and bathing. Inhalation of volatilized chloroform accounts for most of the cumulative risk for this medium. Although the maximum detected concentrations of ethylbenzene and xylene exceeded their respective MCLs in the AS?' area, the results of the Human Health Risk Assessment showed that

exposure to these two COPCs alone over time did not present unacceptable **risks** or hazards to human health based upon their levels of detection throughout the entire Site.

For the evaluation of noncancer human health hazards, potential future industrial/commercial and residential groundwater use exceeded EPA's target hazard index (HI) of 1. For the industrial/commercial worker exposure and both residential scenarios, chloroform was the major contributor. Both adult and child residential HIs exceeded 1 *(255* and 600, respectively), as did the industrial/commercial worker **(330).** Ingestion and inhalation of chloroform contributed to virtually all of the noncancer hazard for the industrial/commercial **worker** and residential groundwater use scenario. Ingestion of iron and manganese also contributed less significantly to the hazard estimates.

All contaminants in the subsurface soil were below levels of concern, and were not carried into the human health risk assessment. On-Site surface soil and soil/sediment in the Gut System did not demonstrate carcinogenic **risks** for the adult industrial/commercial worker, adult and pre-adolescent trespassers and construction workers above EPA's target **risk** range. Noncancer hazards were near or below EPA's HI of 1.**C.** For the construction worker scenario, the total HI was 1.2, although no individual chemical exceeded the HI of 1.0. Arsenic, iron and manganese were included in the Human Health Risk Assessment. However, all **risks** and hazards associated with exposure to these chemicals are within EPA's acceptable levels and by themselves are not considered to be a health concern. They do, however contribute to the overall risk at the Site.

In summary, chloroform in the groundwater is the main risk and hazard driver for the industrial/commercial worker and the adult and child resident for the future groundwater use scenario, with methylene chloride and arsenic contributing to the **risk as** well. Manganese and iron also contributed to the estimated non-cancer risk; however, these compounds are naturally occumng in groundwater and do not have MCLs. Ethylbenzene and xylene did not significantly contribute to the calculated risks, **as** described above. However, ethylbenzene and xylene exceeded their respective MCLs in groundwater in the AST area **and,** therefore arc considered contaminants of concern.

6.2 Environmental Concerns

A Screening Ecological **Risk** Assessment **(SERA)** focused on the drainage channels adjacent to and downstream **of** the Site, including the River Gut (which serves as the northeastern and southeastern Site boundary), Bethlehem Gut, and Fairplain Gut. The **SERA** was developed using data obtained **through** a surface soil/sediment sampling program conducted within the three drainage channels.

In general, aluminum exposure may potentially impact herbivorous, insectivorous, and piscivorous wildlife foraging in the River, Bethlehem and Fairplain **Guts.** Aluminum, chromium, vanadium and zinc, identified for plants, measured adjacent to or downstream of the Site were found at similar or lower concentrations to those measured at the upstream reference location **(RG-2).** This finding suggests that the contaminants of potential ecological concern have been transported from upgradient sources. Historical **(1986)** and current **(1997)** data for soil collected

from the Central and Southern Storm Drains suggest that several metals (e.g., aluminum, manganese, and zinc) may have been historically discharged to downstream areas of the River Gut (near sample location **RG-13).**

The potential contribution of aluminum has decreased over the years, as evidenced by the substantial reduction in concentrations measured in 1997, **as** compared to 1986. In addition, the aluminum concentrations measured in soil **from** the storm drains collected in **I997** were similar to those measured in soil **collected** from **the River *Gut*** upstream of the drain discharge points. Therefore, a current on-Site source of aluminum to **the** River Gut **is** unlikely. The Bethlehem Gut, which contained the second highest concentration of aluminum, also is a potential source of exposure in the Fairplain Gut. **A** bauxite plant is located in close proximity to the Site and serves as a likely source of the aluminum concentrations detected.

7.0 REMEDIAL ACTION OBJECTIVES

The remedy outlined in this ROD is intended to be the final remedial action for the Site. Remedial action objectives (RAOs) are medium-specific (e.g., soil, groundwater, etc.) goals for protecting human health and the environment.

The RAOs for the Virgin Island Chemical Superfund Site are to:

- Mitigate the toxicity, mobility, and/or volume of VOCs (ethylbenzene and xylene) in soils in the AST area so as to minimize continued leaching to groundwater;
- Mitigate the toxicity, mobility, and/or volume of VOCs (ethylbenzene and xylene) in groundwater in the AST area and downgradient so as to achieve MCLs and protect potential future groundwater users;
- Mitigate the toxicity, mobility, and/or volume of chloroform in groundwater in the FPP area and downgradient **so as** to achieve MCLs and protect future potential groundwater users; and
- Restrict on-Site groundwater use to non-potable purposes until the water quality is restored to MCLs.

The Applicable or Relevant and Appropriate Requirements (ARARs) and other To-Be-Considered criteria **(TBCs)** for soil and groundwater remediation at the Virgin Islands Chemical Site are summarized in Table **13.** The groundwater cleanup goals are based upon the primary MCLs for drinking water, as established by federal regulations. There are no promulgated federal or territory cleanup standards for soils. In addition, the results of the baseline **risk** assessment did not identify any unacceptable human health **risks** associated **with** direct exposure **to** the contaminated **soils** at **the** Site. Therefore, Site-specific cleanup goals for Site soil contaminants were developed **as** TBCs using the **EPA** Soil Screening Level (SSL) methodology for the migration to groundwater pathway.

Additional ARARs and/or TBC, specific to remedial treatment system design and operation, will be dictated by the applicable federal and temtorial regulations (e.g., for surface water and air discharges) as referenced in Table 13.

8.0 DESCRIPTION OF ALTERNATIVES

Based on the results of the RI, EPA evaluated five remedial alternatives that would address soil and groundwater contamination at the Virgin Island Chemical Superfund Site.

As part of evaluating alternatives, a soil vapor extraction/air sparging pilot study was performed in Spring 2000 at both the AST and FPP areas to better assess the effectiveness of SVE/AS treatment in these areas. The results of the pilot test supported the following conclusions:

- SVE/AS would be an effective combined technology for removing ethylbenzene and xylene from the AST source area soils and groundwater. AS treatment would also enhance the conditions for aerobic biodegradation of these contaminants.

- SVE/AS would not be effective for treatment of the FPP area, based upon the low air permeability of soils and the low chloroform concentrations remaining in the soils and groundwater in this area. The analytical results of groundwater samples collected prior to, during, and after SVE/AS testing further indicated that chloroform concentrations in groundwater have decreased since 1998 to below the MCL as a result of natural attenuation, excluding a localized area near temporary monitoring well FPP-VMP-1D.

Following completion of the pilot study, five remedial alternatives were developed for evaluation. Four alternatives involved active cleanup measures. One alternative evaluated MNA. Two aliernatives evaluated SVE/AS, combined with MNA in one case and groundwater extraction and treatment in the other case. Groundwater extraction and treatment with MNA was evaluated as the remaining alternative. All of these active cleanup alternatives included institutional controls. As required by CERCLA, a No Further Action alternative was evaluated as a basis for comparison with the other active cleanup methods. The FS Alternatives have been modified to reflect institutional controls that are appropriate to current Site conditions and implementation responsibilities.

The following section describes the remedial alternatives evaluated in the FS for **the** Site. The Selected Alternative is Alternative **3** (*i.e.*, Soil Vapor Extraction/Air Sparging for the AST area, MNA for the FPP area, and Institutional Controls). The Contingency Alternative for groundwater is a combination of Alternative **4** and Alternative **5** (*i.e.*, Soil Vapor Extraction/Air Sparging for the AST Area, Groundwater Extraction and Treatment for the AST and FPP Areas, and Institutional Controls).

Note that the capital cost presented in this section of the **ROD** includes expenses related to the labor, equipment, and material costs **of** construction. Operations and Maintenance (O&M) cost refers to the **cost** over time of operating labor, maintenance, materials, energy, disposal, and administrative activities. Present-worth provides an analysis of the current value of **all costs.**

Present-worth cost is calculated based on a predetermined interest rate and the time period over which an alternative will be completed.

8.1 Alternative 1: No Further Action

Under the No Further Action alternative, no new response actions would be initiated at the Site. The security fence installed in Spring 2000 would remain and be maintained, but the existing SVE/AS system installed for the pilot study in the Spring of 2000 would be rendered non-operational. The potential risks associated with the contamination would not be minimized by this action.

- Incurred capital costs of existing fence: $45,000
- Estimated present-worth O&M costs: $12,000
- Total estimated present-worth cost: $57,000
  (based upon 30 years of maintenance)

8.2 Alternative 2: MNA with Institutional Controls

Alternative 2 would include MNA for COPCs in groundwater in the AST area and FPP area.

Under this alternative, groundwater conditions would be monitored over an assumed period of 15 years using existing wells at the Site, plus additional monitoring wells would be installed at the AST and FPP areas.

The following parameters would be monitored: ethylbenzene and xylene isomers (RST area only), chloroform and dichloromethane (FPP area only), dissolved oxygen, reduction/oxidation (redox) potential, total organic carbon, ferrous iron, sulfate, sulfide, and methane. The monitoring frequency is assumed to consist of quarterly sampling for Year 1, semi-annual sampling for Years 2 and 3, and annual sampling thereafter to Year 15.

The Department of Planning and Natural Resources in consultation with EPA, will utilize institutional controls (in the form of existing well permitting laws and regulations) to limit the pumping of groundwater at the Site to prevent interference with the selected remedy and to also prevent human exposure to contaminated groundwater until MCLs are achieved.

- Estimated capital costs: $116,560
- Estimated present-worth O&M costs: $545,530
- Total estimated present-worth cost: $662,090

8.3 Alternative 3: SVE/AS for the AST Area, MNA for the FPP Area, and Institutional Controls

In addition to the institutional controls identified in Alternative 2, this alternative includes expansion and use of the existing SVE/AS system to treat groundwater, saturated soil, and unsaturated soil at the AST area.

For the AST area, Alternative 3 includes using the existing air sparging system for volatilizing VOCs in shallow groundwater and the soil vapor extraction system to capture sparged vapors from the groundwater and to remove VOCs in the soils above the water table. Additional air sparging/soil vapor extraction wells would be installed during implementation of the remedy to remediate contaminated groundwater and soil in the AST area.

This alternative includes periodic monitoring of the SVE/AS system. Alternative 3 assumes: 1) one year of SVE/AS operation to achieve the SSLs and groundwater MCLs and 2) three years of verification groundwater monitoring after shutdown of the SVE/AS system in the AST area to assure that MCLs are achieved in groundwater.

For the FPP area, MNA would be implemented for low-level residual VOC contamination in groundwater. Alternative 3 includes the same sampling scheme for groundwater monitoring as stated in Alternative 2 for an assumed period of 15 years.

- Incurred capital costs: $ 565,000
- Estimated additional capital costs: $ 285,760
- Estimated present-worth O&M costs: $ 553,500
- Total estimated present-worth cost: $1,404,260

8.4 Alternative 4: SVE/AS for the AST Area, Groundwater Extraction and Treatment for the FPP Area, and Institutional Controls

In addition to the institutional controls identified in Alternative 2, this alternative includes:

- SVE/AS to treat groundwater, saturated soil, and unsaturated soil at the AST area, and
- A groundwater extraction and treatment system to hydraulically control and treat impacted groundwater at the FPP area.

The SVE/AS portion of the remedy in the AST area would be the same as described in Alternative 3

At the FPP area, the groundwater extraction system would be comprised of two extraction wells located approximately 70 feet apart. Each well would be equipped with a submersible pump. The primary extraction well would be located in the area where the highest concentrations of chloroform in groundwater were historically encountered. The secondary extraction well would

be located downgradient of the first well. The combined capture zone from both wells would encompass rhe FPP area and the historic extent of the chloroform plume.

The treatment system would consist of a storage/equalization tank, from which groundwater would be pumped to a low profile air stripper for removal of chloroform. Treated water would be discharged via pipeline to the River Gut.

It is estimated that **5 years** would be required for operation of the groundwater treatment and extraction system to meet MCLs.

Alternative **4** includes the following monitoring scheme:

- Pre- and post-air stripper water sampling to evaluate removal efficiency in the air stripper **and** compliance with surface water discharge limits;
- Periodic air flow monitoring to ensure sufficient air flow from the blower for mass transfer in the stripper;
- Monitoring of differential pressure across the air stripper, in addition to periodic visual inspection of the tray; to evaluate whether fouling or other impediments to air flow have occurred;
- Calculation of mass missions from the air stripper by using the measured concentrations of chloroform in the influent water and treated water and the flow rate from the storage tank to the stripper.
- Assessment of the cone of depression and extent of capture zone induced by the extraction wells by measuring water levels at new and existing groundwater monitoring wells.

Alternative **4** includes the same sampling scheme for groundwater monitoring described in Alternative **2.** It was assumed that monitoring in the FPP area would continue through the operation of the extraction system (i.e., until the attainment of MCLs), plus two years of post-shutdown monitoring.

- Incurred capital costs: **$** 565.000
- Estimated additional capital costs: **$ 654,240**
- Estimated present-worth O&M costs: **$ 877,330**
- Total estimated present-worth cost: **$2,096,570**

8.5 Alternative ***5:*** Groundwater Extraction **and** Treatment **for the** AST Area, **MNA for** the **FPP** Area, **and** Institutional Controls

In addition to the institutional controls identified in Alternative **2,** this alternative includes:

- MNA for impacted groundwater in the FPP area, and a groundwater extraction and treatment system to capture and treat impacted groundwater at the AST area.

At the FPP area, the MNA portion of the remedy would be the same as described in Alternative 2.

At the AST area, the groundwater extraction system would consist of two extraction wells located within the zone of highest xylene and ethylbenzene impacts. The expected combined capture zones of these wells would encompass the entire AST area and the extent of the xylene and ethylbenzene plumes.

The treatment system would be comprised of the same components and be subject to the same monitoring scheme as described in Alternative 4. Treated water would be discharged to the River Gut at a location northeast of the AST area.

Alternative 5 includes the same sampling scheme for groundwater monitoring as identified in Alternative 2. In the FPP area, the assumed duration of monitoring would be 15 years. In the AST area, the assumed duration of monitoring would be seven years (i.e., five years during extraction system operation and two years of post-shutdown monitoring).

• Incurred capital costs:	$ 565,000
• Estimated additional capital costs:	$ 556,480
• Estimated present-worth O&M costs:	$1,030,370
• Total estimated present-worth cost:	$2,151,850

9.0 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

Section 300.430(e)(9) of the NCP requires that EPA evaluate and compare the remedial cleanup alternatives based on the nine criteria listed below. The first two criteria, (1) overall protection of human health and the environment and (2) compliance with applicable or relevant and appropriate requirements (ARARs), are threshold criteria that must be met for the Selected Remedy. The Selected Remedy must then represent the best balance of the remaining primary balancing and modifying criteria.

9.1 NCP Evaluation and Comparison Criteria

9.1.1 Threshold Criteria

(1) **Overall protection of human health and the environment** addresses whether or not a remedy provides adequate protection and describes how risks posed through each exposure pathway (based on a reasonable maximum exposure scenario) are eliminated, reduced, or controlled through treatment, engineering methods, or institutional controls.

(2) **Compliance with applicable or relevant and appropriate requirements (ARARs)** addresses whether or not a remedy would meet all of the applicable or relevant and

appropriate requirements of other federal and state environmental statutes and regulations or provide grounds for invoking a waiver.

9.1.2 Primary Balancing Criteria

(3) **Long-term effectiveness and permanence** refer to the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup goals have been met. It also addresses the magnitude and effectiveness of the measures that may be required to manage the risk posed by treatment residuals and/or untreated wastes.

(4) **Reduction of toxicity, mobility, and volume through treatment** is the anticipated performance of the treatment technologies, with respect to these parameters, that a remedy may employ.

(5) **Short-term effectiveness** addresses the period of time needed to achieve protection and any adverse impacts on human health and the environment that may be posed during the construction and implementation period until cleanup goals are achieved.

(6) **Implementability** is the technical feasibility (*e.g.*, the difficulty of the alternative to construct and operate) and administrative ease (*e.g.*, the amount of coordination with other government agencies) of a remedy, including the availability of necessary materials and services.

(7) **Cost** includes the estimated capital, operation and maintenance, and net present-worth ccsts.

9.1.3 Modifying Criteria

(8) **Territorial acceptance** indicates whether, based on its review of the RI/FS reports and the Proposed Plan, the Territory (VIDPNR) concurs with, opposes, or has no comment on the preferred remedy at the present time.

(9) **Community acceptance** refers to the public's general response to the alternatives described in the Proposed Plan and the RI/FS reports.

9.2 Evaluation of the Alternatives Against the NCP Criteria

This section summarizes the evaluation of the remedial alternatives against the nine NCP criteria. The following subsections are a brief summary of the evaluation and comparison of the alternatives against each criteria. Additional details of the evaluation of the alternatives are presented in the FS.

9.2.1 Overall Protection of Human Health and the Environment

The No Further Action alternative does not address Site risks.

All of the remaining alternatives include a monitoring component to evaluate the protectiveness of the remedy.

Although natural attenuation would still occur under the No Further Action alternative, there would be no verification or measure of the extent to which these processes are occumng.

Alternative 3 would be more effective than MNA alone (Alternative 2) in overall protection of human health, since the inclusion of SVE/AS would remove mass from the AST area more quickly and reduce the amount of time to achieve MCLs and SSLs. Similarly, Alternative 3 would be more effective than Alternative 5 in three ways: (1) SVE would rapidly remove and reduce the contaminant source in the unsaturated zone, whereas groundwater extraction alone would not address the unsaturated zone; (2) AS is expected to be more effective at remediating contaminated groundwater than conventional groundwater extraction and treatment based upon the localized nature of contaminant distribution, higher silt/clay content of the Site soils, and poor yield of the shallow aquifer. AS would also better facilitate aerobic biodegradation processes via introduction of air; and (3) SVE/AS would be more readily implemented considering that a system is already in place from the pilot study.

With respect to Alternative 4, the existing groundwater data indicate that cleanup via groundwater extraction and treatment in the FPP area would occur no more rapidly than via natural attenuation (included as a component in Alternatives 1, 2, 3, and 5). The groundwater data from Spring 2000 indicate that only one temporary monitoring point exhibits chloroform concentrations above its MCL. These findings support the conclusion that natural attenuation is adequately protective without the need for any active extraction system.

9.2.2 Compliance with ARARs

The No Further Action alternative does not include a monitoring component to verify compliance with chemical-specific ARARs for groundwater or soil. Alternatives 1 (No Further Action) and 2 would not achieve compliance with chemical-specific ARARs in the AST area within a time frame that is comparable to that offered by other active remedial alternatives based upon the presence of a residual source. All other alternatives can be implemented to achieve and verify compliance with ARARs within a reasonable time frame.

9.2.3 Long-Term Effectiveness and Permanence

Alternatives 1 and 2 will not provide long-term protection against the risks posed by contaminated groundwater and soils in the AST area. Also, Alternative 1 does not provide a monitoring component to verify the long-term effectiveness of natural attenuation. Alternative 2 will allow Site contaminants to remain in the AST area for a greater period of time than Alternatives 3, 4 and 5. However, off-Site risks to human health and the environment are not expected with any

alternative. A permanent remedy will be achieved more quickly by Alternatives 3 and 4, since contaminant mass will be removed more quickly from the AST area soil and groundwater, rather than by reliance on solely natural biological and physical processes under Alternative 2 or by groundwater treatment alone under Alternative 5. Alternatives 3, 4 and 5 are expected to perform similarly in the FPP area over the long-term, based upon the low concentrations of chloroform remaining in soil and groundwater.

9.2.4 Reduction of Toxicity, Mobility, and Volume through Treatment

Alternatives 1 and 2 do not include remedies that involve active treatment in the AST or FPP areas. Therefore, these alternatives would not actively reduce contaminant toxicity, mobility, or volume. Passive reduction would occur in both areas as a result of natural attenuation processes.

For Alternatives 3 and 5, active control and removal of mass would occur via SVE/AS or groundwater extraction in the AST area, but would not occur in the FPP area. Alternative 4 would control and remove contaminant mass at both the FPP and AST areas using SVE/AS treatment and groundwater extraction and treatment, respectively. However, the relative reduction achieved in the FPP area by pump and treat Alternative 4 would be comparable to that offered by natural attenuation under Alternatives 1, 2, 3 and 5, based upon the low concentrations and limited mass of contamination present in the FPP area.

Alternatives 3 and 4 would also provide secondary reduction of toxicity, mobility, arid volume through treatment by enhancing natural biodegradation processes that will reduce ethylbenzene and xylene mass in the AST area. The oxygen delivered to groundwater via air sparging will likely augment aerobic biodegradation of these contaminants.

9.2.5 Short-Term Effectiveness

The relative short-term effectiveness provided by Alternatives 1 and 2 is comparable and greater than that provided by Akematives 3, 4 and 5, because Alternatives 1 and 2 do not involve the completion of intrusive remedial construction work within areas containing contaminated groundwater or soils.

Alternatives 3, 4 and 5 include the construction of an active remediation system in the AST and/or FPP areas. A limited amount of intrusive construction work (i.e., new SVE/AS wells. groundwater extraction wells, new monitoring wells/points) will be required for these alternatives, within areas containing contaminated groundwater and/or soils, to complete remedial system installation. This work can be completed using conventional construction equipment and techniques and standard measures to ensure worker health and safety. The relative short-term effectiveness achieved by Alternative 3 is greater than that achieved by Alternatives 4 and 5, because a pilot SVE/AS system is already in-place and would only require minor modifications for full-scale implementation. The relative short-term effectiveness provided by Alternatives 4 and 5 is comparable, since both require the installation of groundwater extraction and treatment systems.

9.2.6 Implementability

In general, all five alternatives are implementable. Alternative 1 is the simplest to implement, followed in order of ease by Alternatives 2, 3, 5, and 4, considering that an operational SVE/AS system for Alternatives 3 and 4 already exists at the Site. Materials, services, and equipment associated with the implementation of each remedial alternative are generally available on the U.S. mainland and on larger islands, such as Puerto Rico. Certain units, such as the low-profile air stripper (i.e., Alternatives 4 and 5), and associated spare parts are somewhat less widely available in the Virgin Islands, and would need to be manufactured and shipped from the U.S. mainland, necessitating a longer lead time. Also, Alternatives 3, 5, and 4 (in that order) are increasingly more intensive in terms of operation and maintenance than Alternatives 1 and 2.

9.2.7 Cost

Costs for each remedial alternative increase in the following order: Alternative 1, Alternative 2, Alternative 3, Alternative 4, and Alternative 5. However, most of the capital costs for the SVE/AS system associated with Alternatives 3 and 4 have already been incurred as a result of the pilot SVE/AS system.

9.2.8 Territorial Acceptance

VIDPNR has been consulted throughout this process and concurs with ths Selected Remedy, Alternative 3, and tne Contingency Remedy, a combination of Alternatives 4 and 5 for groundwater only.

9.2.9 Community Acceptance

Public comment on the RI, FS, and Proposed Plan was solicited during a formal public comment penod originally designated from June 27 to Jaly 27,2001. In response to public request for additional time, EPA extended ths public comment period an additional 15 days to August 10, 2001. Comments generally favored the Preferred Alternative. Appendix C contains a summary of community responses to the Selected Remedy.

10.0 PRINCIPLE THREAT WASTES

The NCP establishrs an expectation that EPA will use treatment to address the principle threats posed by a Site wherever practicable (NCP Section 300.430(a)(1)(iii)(A)). Identifying principle threat wastes combines concepts of both hazard and risk. In general, principle threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur. Conversely, non-principle threat wastes are those source materials that generally can be reliably contained and that would present only a low risk in the event of exposure. The manner in which principle threats are addressed generally will determine whether the statutory preference for treatment as a principle element is satisfied.

The source materials identified at the Site include contaminated soils and groundwater in the AST area. The predominant contaminants of potential concern are ethylbenzene, xylene, and chloroform. These source materials constitute principle threat wastes; therefore, the statutory preference for treatment is applicable to the AST area.

In the FPP area, groundwater is impacted by chloroform. However, recent groundwater sampling results indicate that the chloroform concentration has decreased since 1998 to below its MCL as a result of natural attenuation, excluding a localized area near temporary monitoring well FPP-VMP-1D.

In Spring 2000, a soil vapor extraction/air sparging pilot study was performed at both the AST and FPP areas to better assess the effectiveness of SVE/AS treatment in these areas. Results of the pilot study supported these conclusions:

- SVE/AS would be an effective technology for removing ethylbenzene and xylene from the AST source area soils and groundwater. AS treatment would also enhance the conditions for aerobic biodegradation of these contaminants.

- SVE/AS would not he effective for treatment of the FPP area, based upon the low air permeability of soils and the low chloroform concentrations remaining in the soils and groundwater in this area.

In addition, recent groundwater sampling (November 2001) in the AST area has shown that concentration of toluene, ethylbenzene and xylenes are below the MCLs. Thus, SVE/AS is a reliable remedy to accomplish active source control and contaminant mass removal in the AST area. Based upon the low concentrations and limited mass of contamination in the FPP area, natural attenuation is expected to continue to reduce chloroform levels.

11.0 SUMMARY OF THE SELECTED REMEDY

Based upon consideration of CERCLA requirements, the detailed analysis of alternatives, and public comments, EPA has determined that Alternative 3 (SVE/AS for the AST Area, MNA for the FPP Area, and Institutional Controls) is the appropriate remedy for the Virgin Island Chemical Superfund Site. EPA has also selected a contingent remedy in the AST and FPP areas which includes a groundwater extraction and treatment remedy to assure the MCLs for groundwater are achieved in a reasonable time frame.

11.1 Rationale for Selected Remedy

Alternative 3 either meets or exceeds benefits associated with the selecting criteria when compared to the other alternatives. The Selected Remedy will reduce risk to human health and the environment through the following:

- As required, Alternative 3 meets the threshold cleanup evaluation criteria (overall protection of human health and the environment and compliance with ARARs).

- Alternative 3 provides very good long-term effectiveness and permanence.
- Alternative 3 actively controls the source materials and removes contaminant mass in the AST area.
- Alternative 3 mitigates the human health risks (defined by the risk assessment).
- Alternative 3 is readily implementable. An operational SVE/AS system for Alternative 3 already exists at the Site.
- Alternative 3 offers a cost-effective solution that meets the cleanup goals for the Site.

The Selected Remedy achieves the appropriate balance considering Site-specific conditions and criteria identified in CERCLA and the NCP. The contingency remedy (Alternatives 4 and 5) also achieves these criteria.

11.2 Description of the Selected Remedy

The principle components of the Selected Remedy (Alternative 3) are as follows:

SVE/AS for the AST Area

- The existing SVE/AS system will be expanded to actively treat the entire volume of 1) contaminated groundwater exceeding MCLs and 2) contaminated soils exceeding SSLs. Air sparging will be used to strip VOCs from groundwater, and soil vapor extraction will be used to recover sparged VOC vapors and to remove VOCs from the unsaturated zone soils.
- SVE/AS system performance monitoring will be required throughout the duration of the system operation and maintenance to verify and monitor treatment system performance and to assess remedial progress, as approved by EPA.
- SVE/AS system operation will continue to operate until the EPA's SSLs in soils and groundwater MCLs are achieved. It is anticipated that SSLs and MCLs will be achieved in less than five years.
- Air discharge criteria and compliance monitoring will be in accordance with federal and territorial requirements.
- Achievement of soil cleanup goals will be verified by collecting confirmatory soil samples across the impacted area. Sampling will be performed using an appropriate grid system, with samples collected at appropriate depth intervals to the water table at each grid node within the contaminated area.

- Long-term groundwater monitoring and reporting will be initially performed on a quarterly basis. Groundwater samples will be collected for VOCs analysis, and field measurements will be taken for water quality parameters (*i.e.*, dissolved oxygen, conductivity, temperature, pH, and oxidation reduction potential) at MW-I, MW-6, MW-8, MW-10, and at least three additional monitoring wells to be installed at locations approved by EPA. Water level measurements will be taken at all existing monitoring wells/points. The frequency of long-term monitoring will be subjected to annual review and may be modified, as approved by **EPA.** Long-term groundwater monitoring will continue until the groundwater quality achieves MCLs.

MNA for the FPP Area

- Long-term groundwater monitoring and reporting will be initially performed on a quarterly basis. Groundwater samples will be collected for VOCs analysis, and field measurements will be taken for water quality parameters at MW-2, MW-7, MW-11, MW-13, and at least three additional, existing and/or new monitoring wells approved by **EPA.** In addition, samples will be collected for analysis of intrinsic biodegradation parameters (*e.g.*, total organic carbon, nitrate, sulfate, ferrous iron, hydrogen sulfide, methane) at **MW-2,** MW-I1, and at least two other well locations approved by **EPA.** Water level measurements will be taken at all existing monitoring wells/points. The frequency of long-term monitoring will be subjected to annual review and may be modified, as approved by EPA. Long-term groundwater monitoring will continue until the groundwater quality conforms with MCLs.

a The environmental monitoring results from the FPP area will be used to confirm that the **VOC** plume is attenuating and that its leading edge is not advancing downgradient. Downgradient monitoring wells, as identified above, will be used to track the VOC plume exceeding MCLs. The monitoring results will also be compared against feasibility study estimates regarding natural attenuation rates, with the results of updated trend analyses included as part of quarterly remedial progress reports.

- Groundwater extraction and treatment has been retained as a contingency reinedy for this and the AST area, as described in Section 11.3, which will be implemented in the future, if warranted based upon monitoring results. The decision to implement the contingency remedy will be based upon evidence (e.g. statistical analysis, modeling) that the VOC plume is attenuating at rates that are significantly less than feasibility study predictions and that are less than cleanup rates that could otherwise be achieved by the contingency remedy.

Institutional Controls

- The Department of Planning and Natural Resources in consultation with **EPA,** will utilize institutional controls **(in** the form of existing well permitting laws and regulations) to limit the pumping of groundwater at the Site to prevent interference with the selected remedy

and to also prevent human exposure to contaminated groundwater until MCLs are achieved.

11.3 Description of Contingency Remedy

In addition to the Selected Remedy, EPA has retained groundwater extraction and treatment as a contingency remedy for groundwater at the AST and FPP areas. The contingency remedy will be implemented in the event that the VOC plume is attenuating at rates that are significantly less than feasibility study predictions and that are less than cleanup rates that could otherwise be achieved by the contingency remedy. The total capital cost of the contingency groundwater remedy for the AST and FPP areas is $1,067,840.

The contingency remedy for the AST Area and FPP Area groundwater includes:

- Installation of one or more groundwater extraction wells to achieve hydraulic control of groundwater exceeding MCLs and to actively remove VOCs from the aquifer.
- Above-ground treatment of groundwater using air stripping to reduce VOC concentrations below the VIDPNR criteria permitted for subsequent surface water discharge to the River Gut.
- Completion of treatment system performance and compliance monitoring and long-term groundwater monitoring, as generally described in Section 11.2, until MCLs are achieved.

12.0 STATUTORY DETERMINATIONS

Under CERCLA Section 121, EPA must select a remedy that is protective of human health and the environment, that complies with ARARs, is cost effective, and uses permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that include treatment as a principle element, which permanently and significantly reduces the volume, toxicity, or mobility of hazardous substances.

12.1 Protection of Human Health and the Environment

The Selected Remedy will protect human health and the environment through the use of an SVE/AS system which will remove ethylbenzene and xylene from the AST source area soils and groundwater to achieve MCLs and SSLs. AS treatment will also enhance conditions for aerobic biodegradation of these contaminants. Natural attenuation will continue to be implemented in the FPP area for low-level residual VOC contamination in groundwater. Additionally, institutional controls will be implemented at the Site to reduce the potential for human exposure to contaminants. These controls will restrict land and/or groundwater use until the SSLs and MCLs are achieved.

In addition to source control via SVE/AS, a groundwater extraction and treatment system to capture and treat impacted groundwater at the AST area was considered in the FS process. Of the two treatment options, SVE/AS treatment was considered more effective for these reasons: (1) SVE would rapidly remove and reduce the contaminant source in the unsaturated zone, whereas groundwater extraction alone would not address the unsaturated zone; **(2)** AS is expected to be more effective at removing contaminants from groundwater than conventional groundwater extraction and treatment based upon the localized nature of contaminant distribution, higher silt/clay content of the Site soils, and poor yield of the shallow aquifer. AS would also better facilitate aerobic biodegradation processes via introduction of air; and (3) SVE/AS would be more readily implemented considering that a system is already in place from the pilot study.

12.2 Compliance with ARARs

The Selected Remedy will comply with all ARARs for the Site; no waivers will be necessary. The Site groundwater quality will be restored to federal MCLs for drinking water (40 CFR Part 141), and the impacted subsurface soils will be restored to EPA SSLs (which are TBCs) for protection of groundwater quality. The SVE/AS system will operate in accordance with national emissions standards for hazardous air pollutants (NESHAPS; 40 CFR Part 161) and territorial air pollution control requirements (VIC, Title **12,** Chapter 9). Well installation **and** abandonment will be performed in accordance with Territorial requirements (VIC Title 12, Chapter *5).*

12.3 Cost Effectiveness

The Selected Remedy is cost-effective and represents a reasonable value for the money to be spent. In making this determination, the following definition was used: **"A** remedy shall be ccst-effective if its costs are proportional to its overall effectiveness" [NCP Section 300.430(f)(ii)(D)]. This was accomplished by evaluating the "overall effectivecess" of those alternatives tha? satisfied the threshold criteria (*i.e.*, were both protective of human health and the environment and ARAR-compliant). Overall effectiveness was evaluated by assessing three of the five balancing criteria in combination (*i.e.*, long-term cifectiveness and permanence; reduction of toxicity, mobility, and volume through treatment; and short-term effectiveness). Overall effectiveness **was** then compared to costs to determine cost-effectiveness. The estimated present worth cost of the Selected Remedy is $1,404,260. A significant portion of the capital costs for **the** SVE/AS system associated with the remedy have already been incurred **as** a result of the pilot SVE/AS system.

12.4 Utilization of Permanent Solutions and Alternative Treatment Technologies (or Resource Recovery Technologies) to the Maximum Extent Practicable

The Selected Remedy utilizes permanent solutions and treatment technologies to the maximum extent practicable. In the AST area, the existing SVE/AS system will be used to actively treat **and** remove contaminant **mass** from **AST** area soil and groundwater. SVE/AS provides **is** a permanent remedy, which will be achieved more quickly **than** other alternatives relying on natural biological and/or physical processes alone. In the FPP area, MNA **will** be implemented to achieve reduction in chloroform levels in groundwater comparable to that offered by **an** active extraction system. Based upon the low concentrations **of** chloroform remaining in soil and groundwater, natural

attenuation is expected to perform similarly in the FPP area over the long-term. Together, SVE/AS and MNA provide the highest effectiveness at the least cost.

Of those alternatives that are protective of human health and the environment and comply with ARARs, EPA has determined that the Selected Remedy for the Site provides the best balance in terms of long-term effectiveness and permanence, treatment, implementability, cost, and territorial anti community acceptance.

12.5 Preference for Treatment as a Principle Element

An SVE/AS pilot study was performed in Spring 2000 at both the AST and FPP areas to better assess the effectiveness of SVE/AS treatment in these areas. The results of the pilot test supported the conclusions that: (1) SVE/AS would be an effective technology for removing ethylbenzene and xylene from the AST source area soils and groundwater, (2) AS treatment would also enhance the conditions for aerobic biodegradation of these contaminants, and (3) SVE/AS would not be effective for treatment of the FPP area, based upon the low air permeability of soils and the low chloroform concentrations remaining in the soils and groundwater in this area.

The Selected Remedy satisfies the statutory preference for treatment by using the operational SVE/AS system that already exists at the Site to treat groundwater, saturated soil, and unsaturated soil at the AST source area. Additionally, MNA will be implemented in the FPP area for low-level residual VOC contamination in groundwater, supported by recent data which indicate that natural attenuation is adequately protective without the need for active treatment. The Selected Remedy is both technically practicable and cost effective as a result of implementation of the pilot system.

12.6 Five-Year Review Requirements

Because contaminated soils and groundwater may remain oil-Site above levels that allow for unlimited use and unrestricted exposure for approximately 5 years, the Selected Remedy will be reviewed no less often than once every five years consistent with Section 121 of CERCLA and Section 300.430(f)(4)(ii) of the NCP. The 5-year review includes a review of the groundwater monitoring data and an evaluation as to how well the Selected Remedy is achieving the RAOs and ARARs that it was designed to meet.

13.0 DOCUMENTATION OF SIGNIFICANT CHANGES

The Proposed Plan for soil and groundwater contamination in the AST and FPP areas at the Virgin Island Chemical Superfund Site was released for public comment in June 2001. The Proposed Plan identified Alternative 3, Soil Vapor Extraction/Air Sparging (SVE/AS) with MNA and Institutional Controls, as the Preferred Alternative. Alternative 4 was also identified as the Contingency Remedy at that time. Comments were received during the public comment period. No significant changes were made to the Preferred Alternative with the exception of including a contingent remedy for groundwater in the AST area in the event that the SVE/AS remedy fails to

meet performance standards. The contingent remedy shall be groundwater extraction and treatment in the **AST** and FPP areas to assure that MCLs for groundwater are achieved in a reasonable time frame.